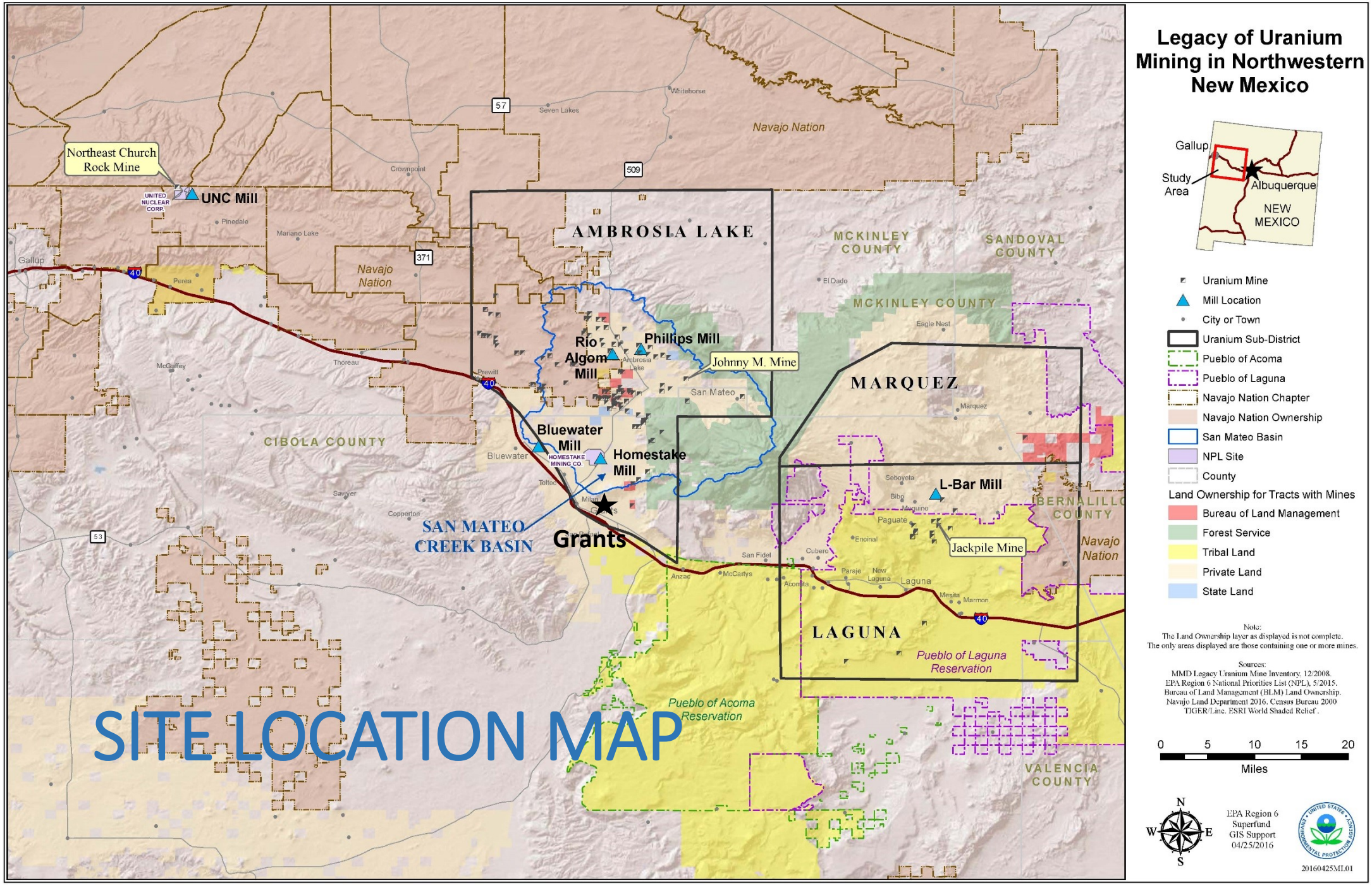
EPA REGION 6
GROUND WATER INVESTIGATION

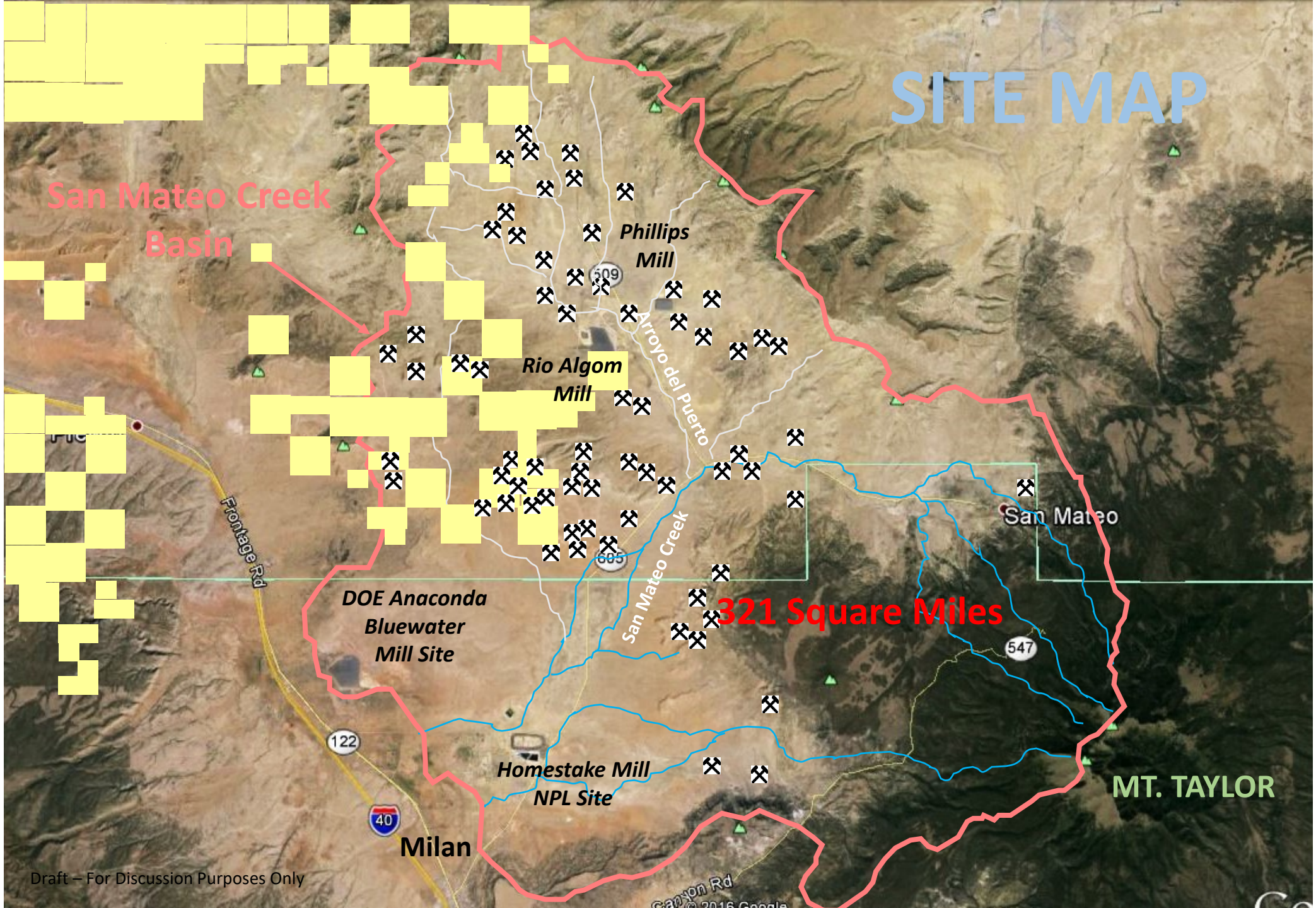
San Mateo Creek Basin Uranium Legacy Site
Tronox NAUM Ambrosia Lake Impact Area

Tronox Quarterly Meeting

October 19, 2016

9881816


Legacy of Uranium Mining in Northwestern New Mexico
Gallup
Study Area
Albuquerque
NEW MEXICO
Uranium Mine
Mill Location
City or Town
Uranium Sub-District
Pueblo of Acoma
Pueblo of Laguna
Navajo Nation Chapter
Navajo Nation Ownership
San Mateo Basin
NPL Site
County
Land Ownership for Tracts with Mines
Bureau of Land Management
Forest Service
Tribal Land
Private Land
State Land
Note:
The Land Ownership layer as displayed is not complete.
The only areas displayed are those containing one or more mines.
Sources:
MMD Legacy Uranium Mine Inventory. 12/2008.
EPA Region 6 National Priorities List (NPL), 5/2015.
Bureau of Land Management (BLM) Land Ownership.
Navajo Land Department 2016. Census Bureau 2000
TIGER/Line. ESRI World Shaded Relief.
0 5 10 15 20
Miles
N
W
E
S
EPA Region 6
Superfund
GIS Support
04/25/2016
20160425ML01
Northeast Church Rock Mine
UNITED NUCLEAR CORP.
UNC Mill
AMBROSIA LAKE
Rio Algom Mill
Phillips Mill
Johnny M. Mine
Bluewater Mill
HOMESTAKE MINING CO.
Homestake Mill
SAN MATEO CREEK BASIN
Grants
MARQUEZ
L-Bar Mill
Jackpile Mine
LAGUNA
Pueblo of Laguna Reservation
Pueblo of Acoma Reservation
Navajo Nation
CIBOLA COUNTY
MCKINLEY COUNTY
SANDOVAL COUNTY
BERNALILLO COUNTY
VALENCIA COUNTY
Gallup
Perea
Pinedale
Mariano Lake
Crownpoint
Whitehorse
Seven Lakes
Thoreau
McGaffey
Prewitt
Bluewater
Toltec
Milan
Savoyer
Copperton
San Mateo
Ambrosia Lake
El Dado
Eagle Nest
Marquez
Seboyeta
Bibo
Mesquino
Paguate
Encinal
Cubero
San Fidel
Anzac
McCartys
Acomita
Paraje
New Laguna
Laguna
Mesita
Marmon
SITE LOCATION MAP



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PROJECT OBJECTIVE

Investigate legacy uranium mining and milling impacts to ground water

MULTI-PHASED INVESTIGATION

Phase 1

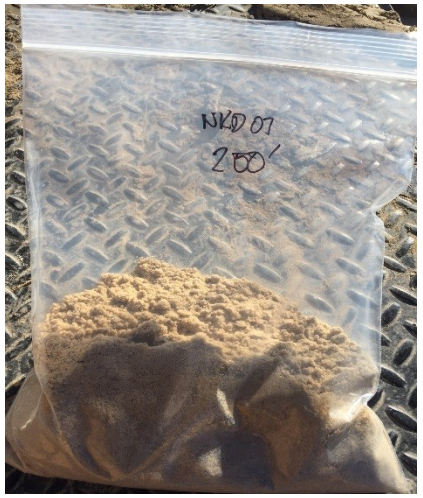
Alluvial Aquifer
San Mateo Creek Basin
2012 – 2016

Phase 2

Bedrock & Alluvial Aquifers
Tronox NAUM Ambrosia Lake Impact Area
2015 – 2017

Phase 3

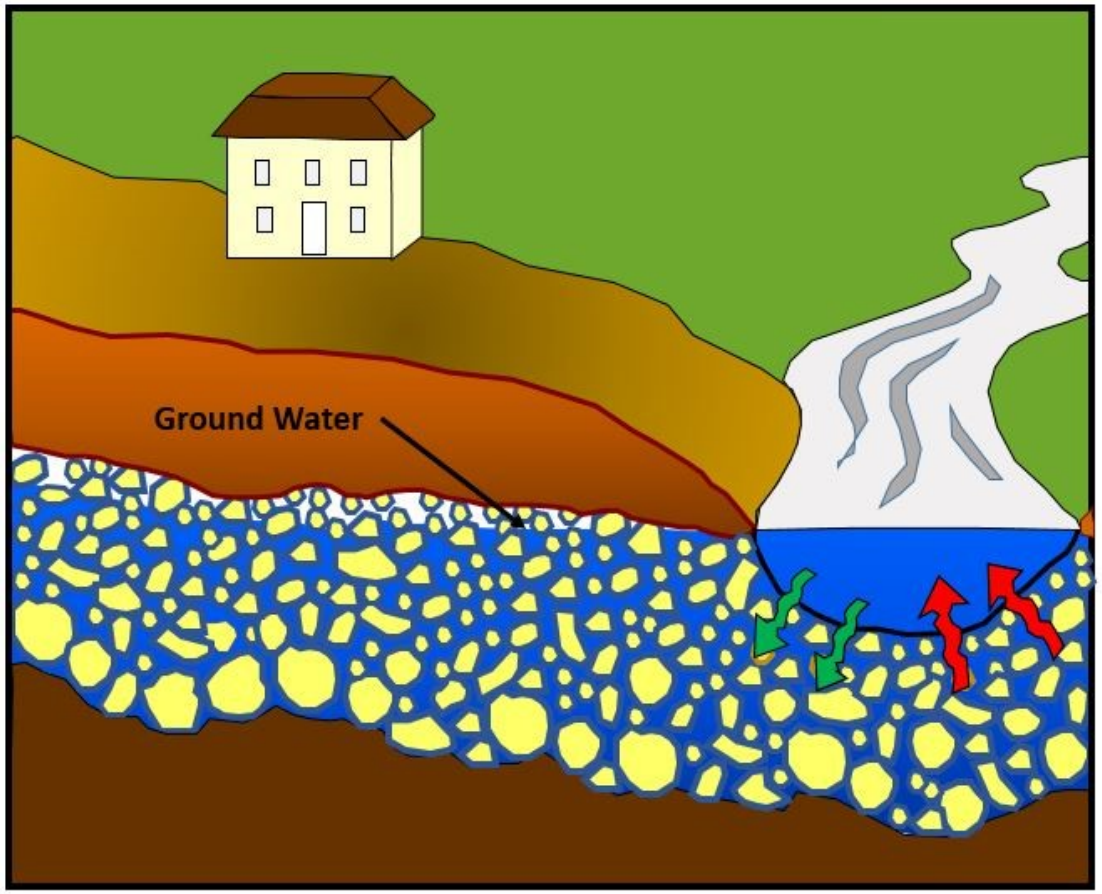
Develop Conceptual Site Model for Tronox NAUM Impacts
2016 - 2018



PRELIMINARY CONCEPTUAL SITE MODEL

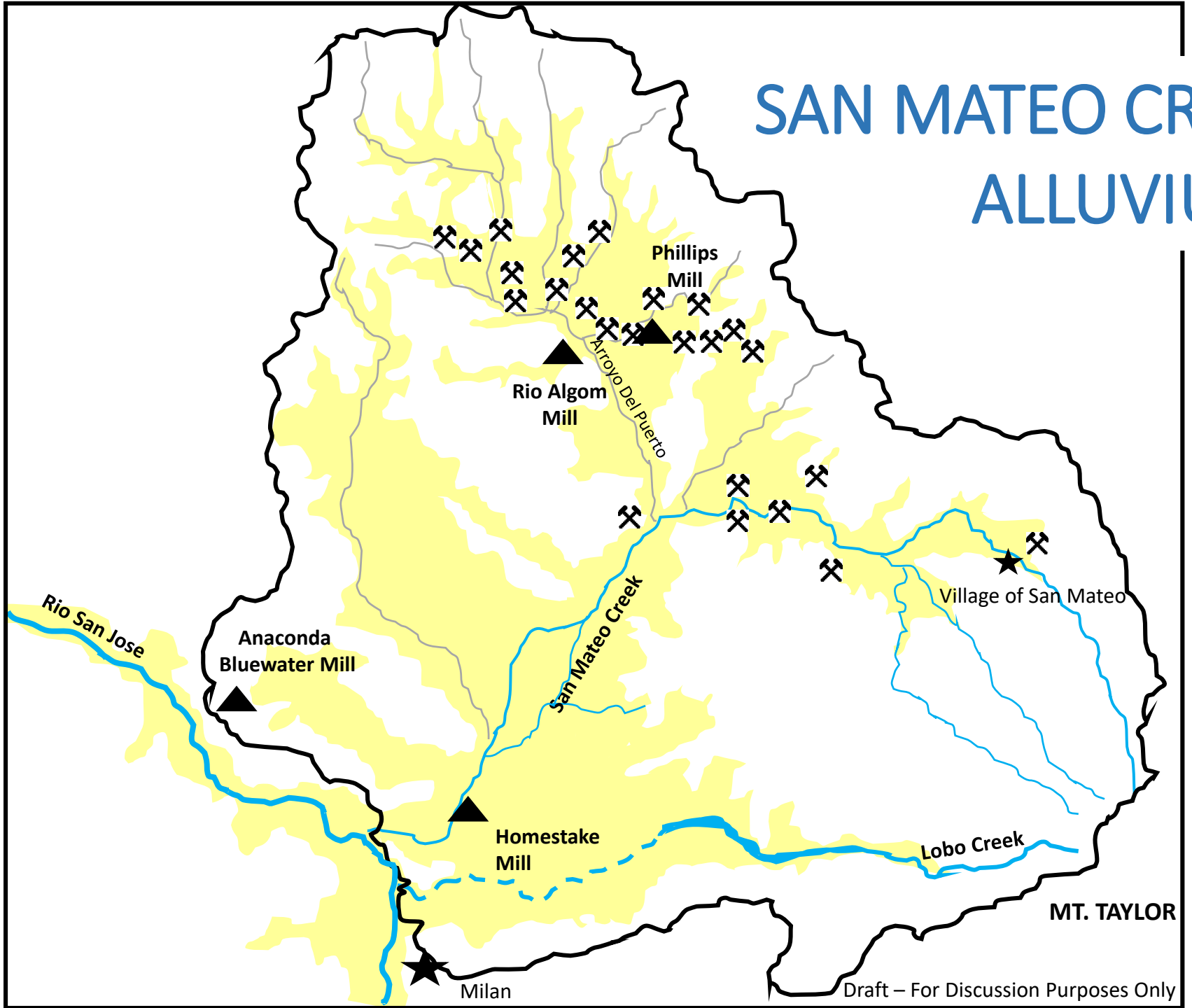
What Do We Need to Know?

- Alluvial Aquifer
  - Where are the alluvial sediments?
  - Where is the ground water?
  - What is direction of flow?
- Bedrock Aquifers
  - What is the underlying bedrock hydrogeology?
  - What is the hydraulic relationship between alluvial and bedrock aquifers?



Modified from City of Las Cruces Poster Display

SAN MATEO CREEK BASIN ALLUVIUM



Alluvium

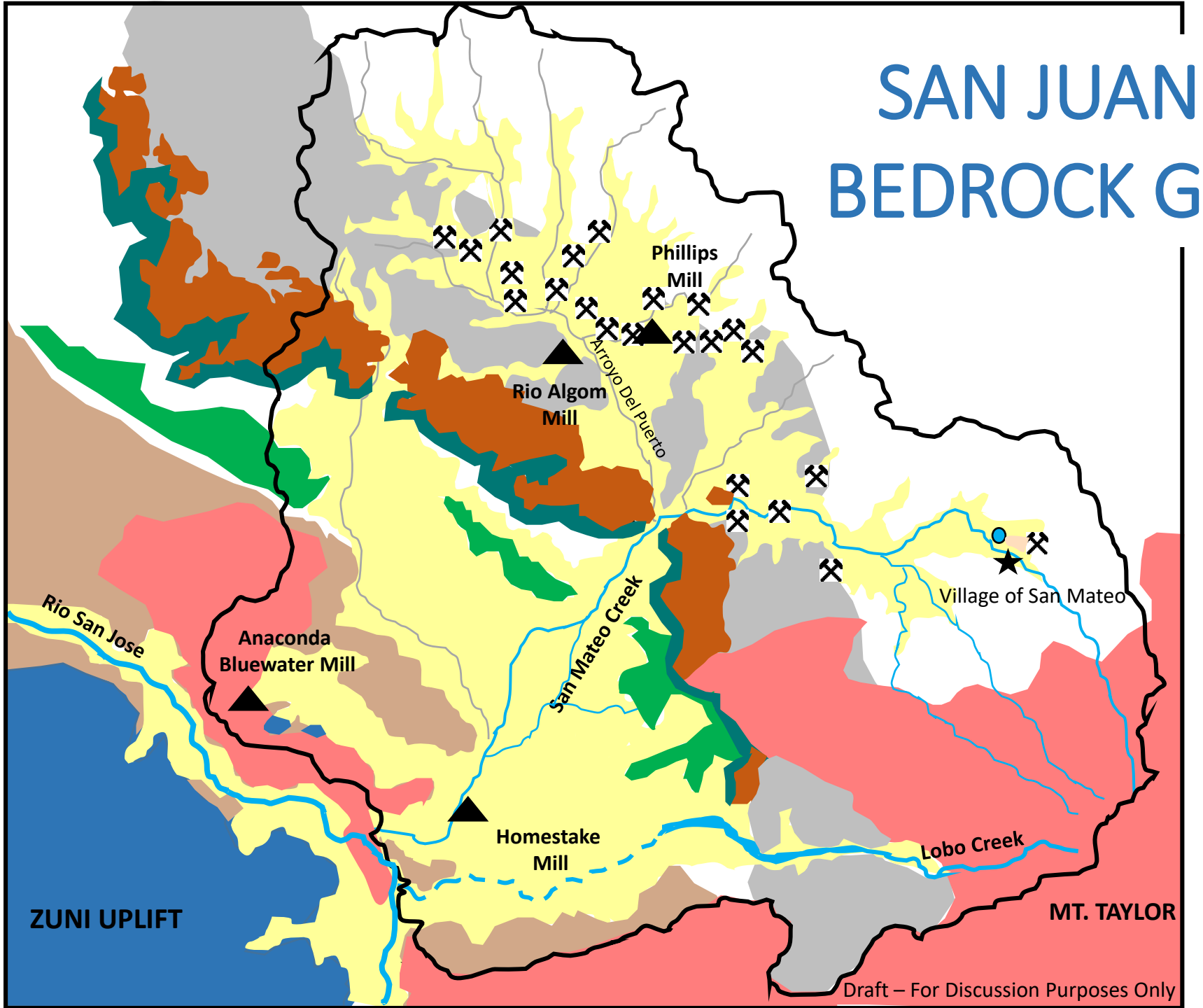
Wet Mine

ALLUVIUM:

Sediments Eroded from Bedrock;

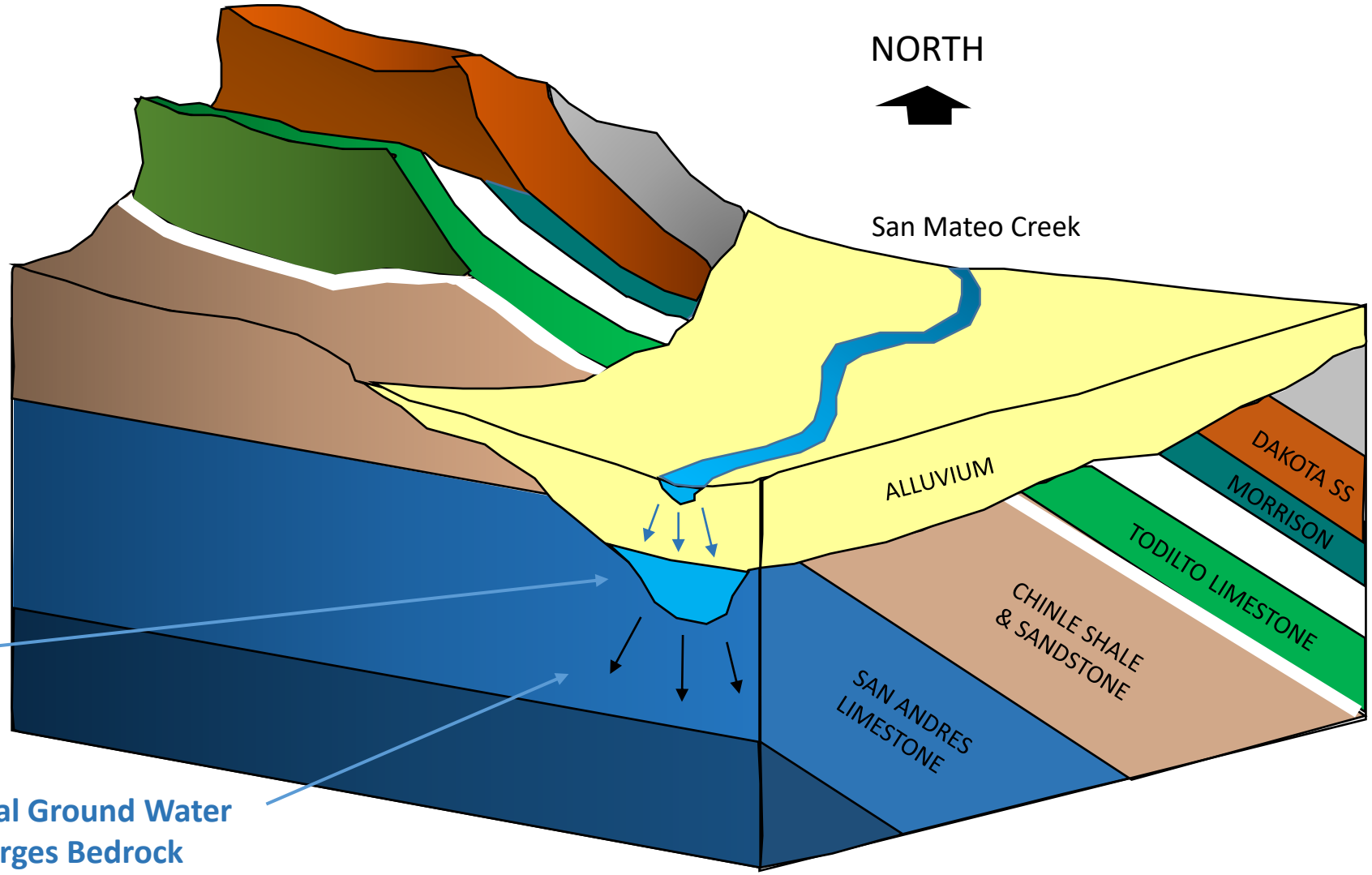
Comprised of Sand, Silt, Clay and Gravel

SAN JUAN BASIN BEDROCK GEOLOGY



- Alluvium
- Mancos Shale
- Dakota Sandstone
- Morrison Fm
- Todilto Limestone
- Chinle Shale and Sandstone
- San Andres/Glorietta Limestone
- Volcanic
- Former Uranium Mill
- Wet Mine

CONCEPTUAL SITE GROUND WATER MODEL



Surface Water Recharges Alluvium

Alluvial Ground Water Recharges Bedrock Aquifers

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EXPOSED AND TILTED BEDROCK FORMATIONS

San Mateo Creek Basin

PHASE 1 COMPLETED

- **EPA Phase 1 Ground Water Report**
  - Completed in August 2016
  - Released to stakeholders in September 2016
- Key components include:
  - Historical studies on uranium mining impacts
  - Field investigation
  - Conclusions

HISTORICAL STUDIES ON URANIUM MINING IMPACTS

- 1975 EPA study
  - Ground water contamination discovered
  - Sources – mine water discharge and tailing seepage
  - Perennial flows created in creeks/arroyos
- 1981 and 1986 New Mexico studies
  - Alluvial ground water exceeds standards
  - Mine water discharge rapidly infiltrates and saturates alluvium

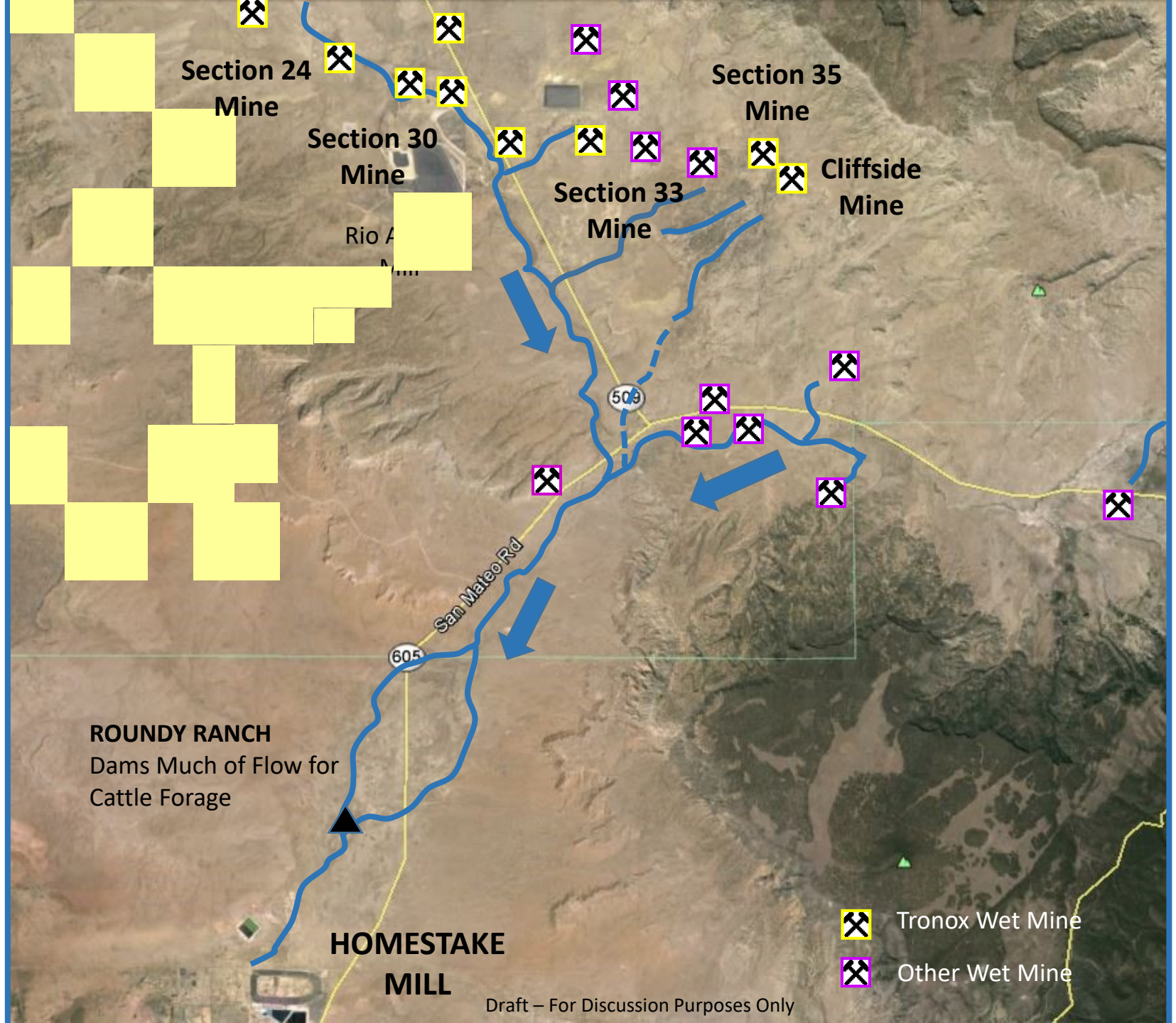
1975 – Ambrosia Lake Area

SUMMARY OF HISTORIC MINE WATER DISCHARGE QUALITY

Comparison to Alluvial Background Water Quality

Contaminant	1981 Mine Water Discharge Ambrosia Lake Area	1981 Mine Water Discharge San Mateo Area	1978-80 San Mateo Creek Upland Alluvial GW (Background)
Gross Alpha (pCi/L)	580	1,100	2.5 – 15.0
Uranium (mg/L)	2.4	0.080	0.005 – 0.010
Selenium (mg/L)	0.410	0.040	0.005 – 0.005
Molybdenum (mg/L)	0.79	0.32	0.005 – 0.010
Chloride (mg/L)	90	10	3 – 8
Sulfate (mg/L)	837	205	5-20
Total Dissolved Solid (ppm)	1,690	520	125 – 300

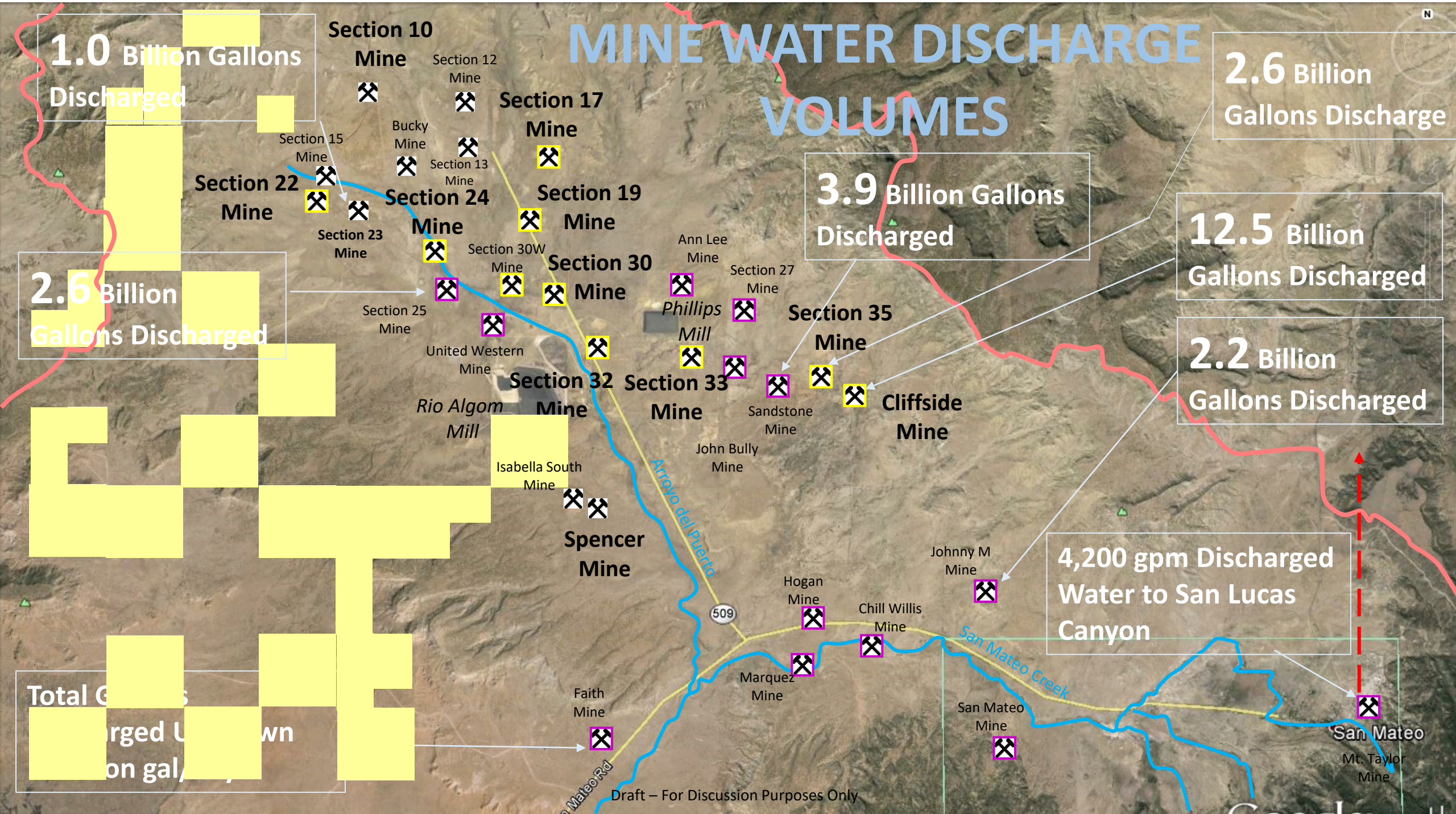
New Mexico 1981 and 1986 Reports

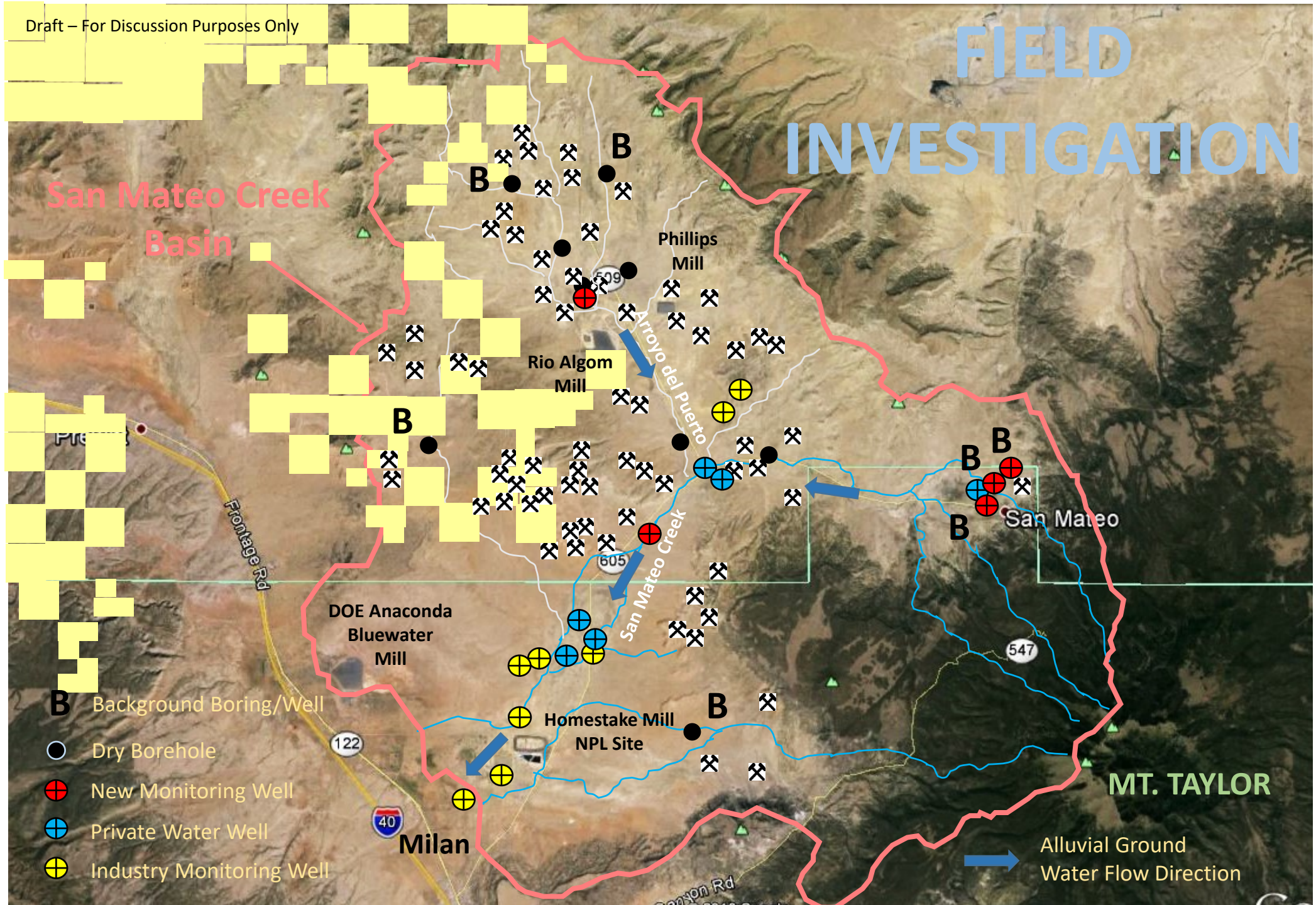


MINE WATER DISCHARGE

Artificially Created Perennial Flows Observed to Reached Homestake Impoundment (EPA 1980)

MINE WATER DISCHARGE VOLUMES

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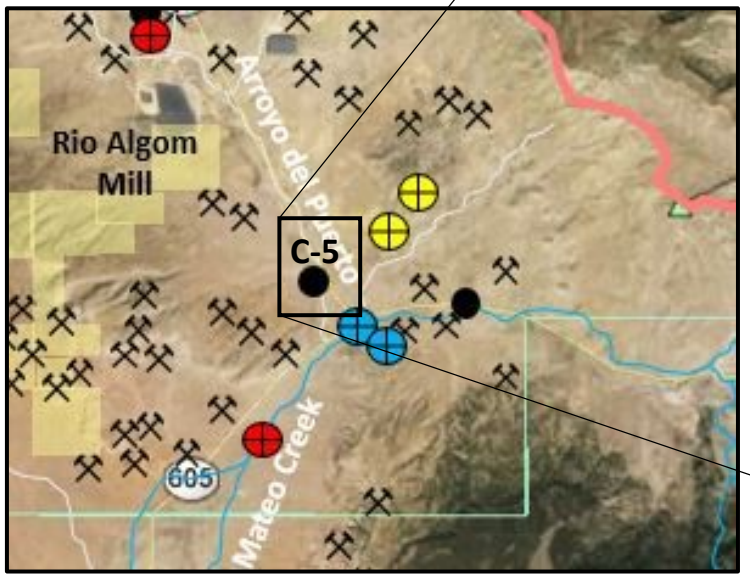
FIELD INVESTIGATION
San Mateo Creek Basin
Phillips Mill
Rio Algom Mill
Arroyo del Puerto
San Mateo Creek
DOE Anaconda Bluewater Mill
Homestake Mill NPL Site
San Mateo
Milan
MT. TAYLOR
Frontage Rd
B
Background Boring/Well
Dry Borehole
New Monitoring Well
Private Water Well
Industry Monitoring Well
Alluvial Ground Water Flow Direction

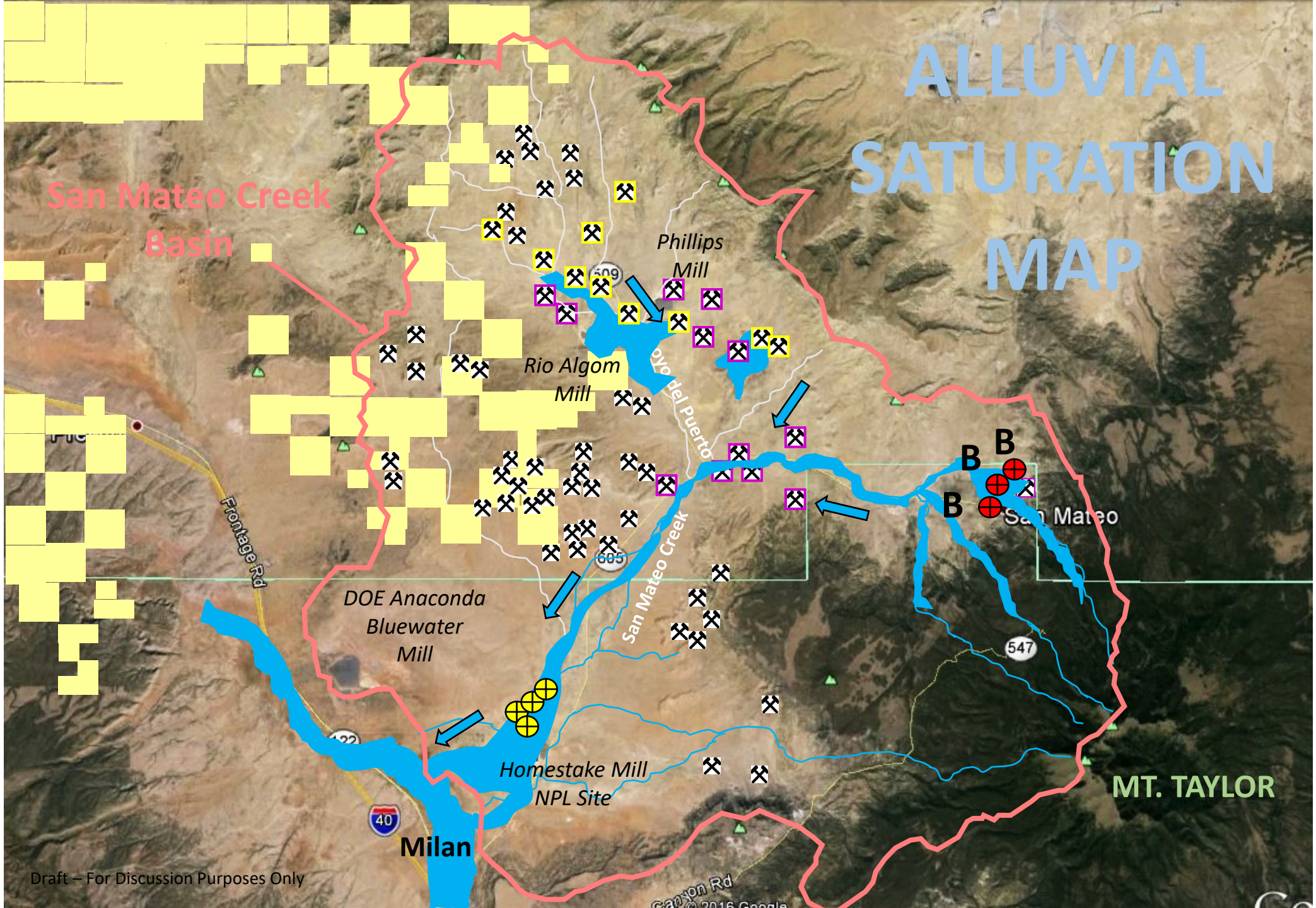
MULTIPLE BORINGS DRILLED TO FIND ALLUVIAL WATER

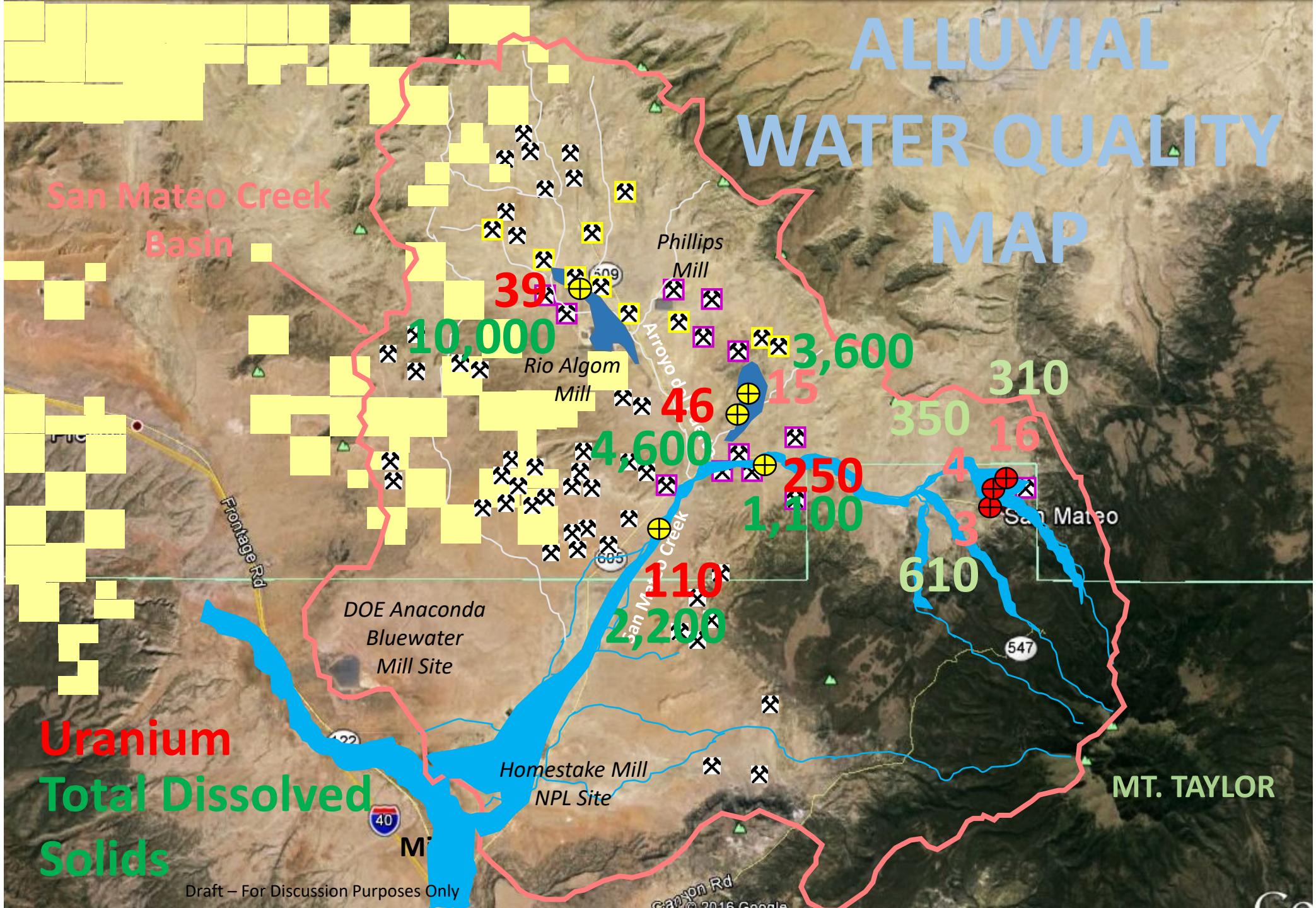


SUMMARY OF CONCLUSIONS

Phase 1 Report

- Attempt to Characterize Alluvial Background had Mixed Results
  - Lack of Natural Saturation in Many Areas Investigated
- Alluvial Water Quality Varies Across Basin
  - Good quality upgradient of mines and mills
    - ✓ Meets standards
  - Poor quality downgradient of mines and mills
    - ✓ Exceeds standards
    - ✓ Similar to mine discharge water quality
- Mine Discharge Water Draining Through and Out of Alluvium


ALLUVIAL SATURATION MAP
San Mateo Creek Basin
Phillips Mill
Rio Algom Mill
Ovejo del Puerto
San Mateo Creek
DOE Anaconda Bluewater Mill
Homestake Mill NPL Site
Milan
Frontage Rd
San Mateo
MT. TAYLOR
B
B
B
609
605
547
40
Draft – For Discussion Purposes Only



EPA Background Well

Well Downgradient to Legacy Mines

16 Uranium (ppb)

16 Total Dissolved Solids (ppm)

Alluvial Water

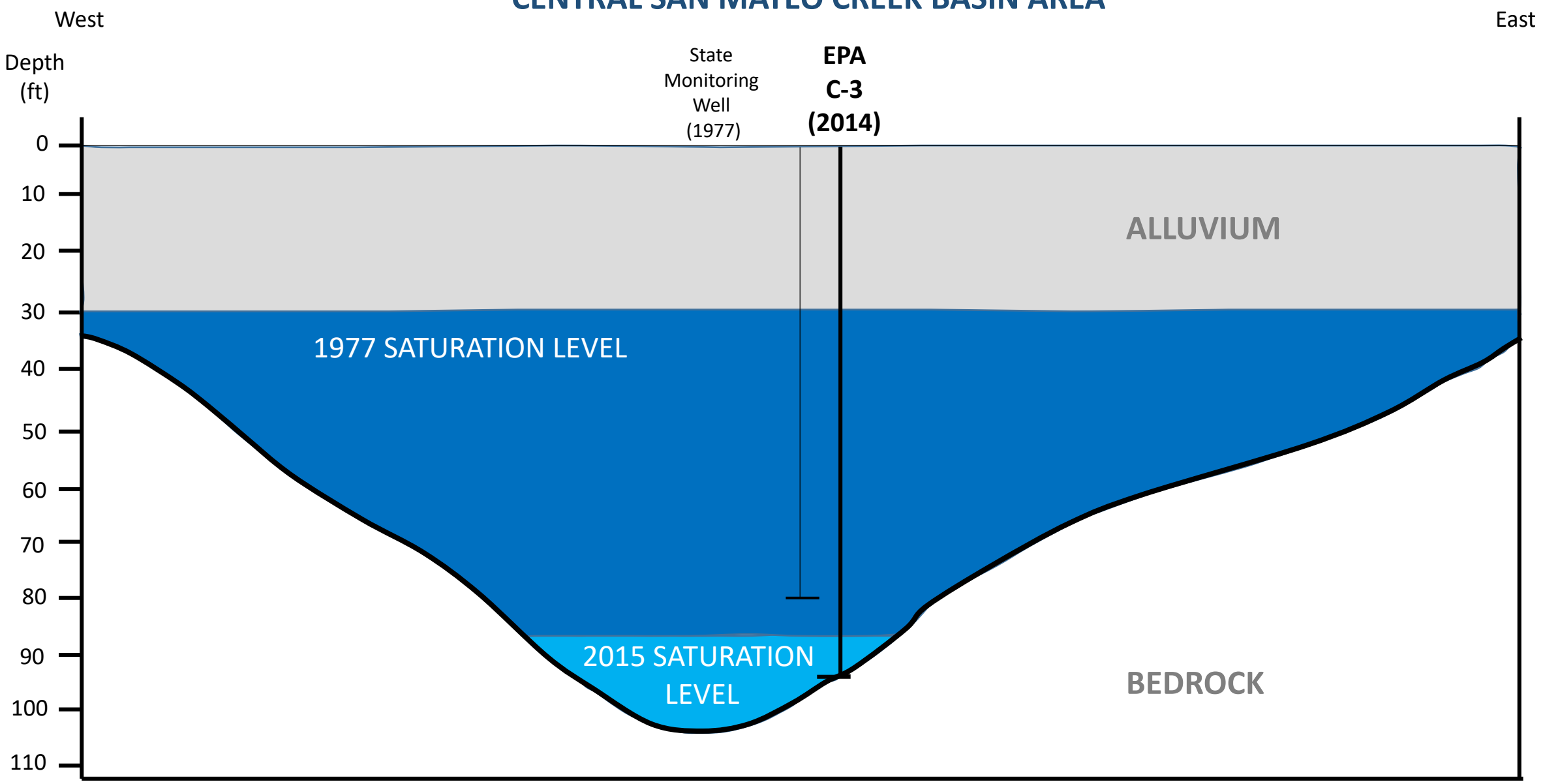
Mine Water Discharge

MASSIVE SATURATION AND DRAIN DOWN OF ALLUVIUM

- Caused by mine water discharges
- Water levels in central part of basin raised and dropped **over 50 feet**
- Drain down not observed near Homestake

CROSS SECTION A-A'

CENTRAL SAN MATEO CREEK BASIN AREA



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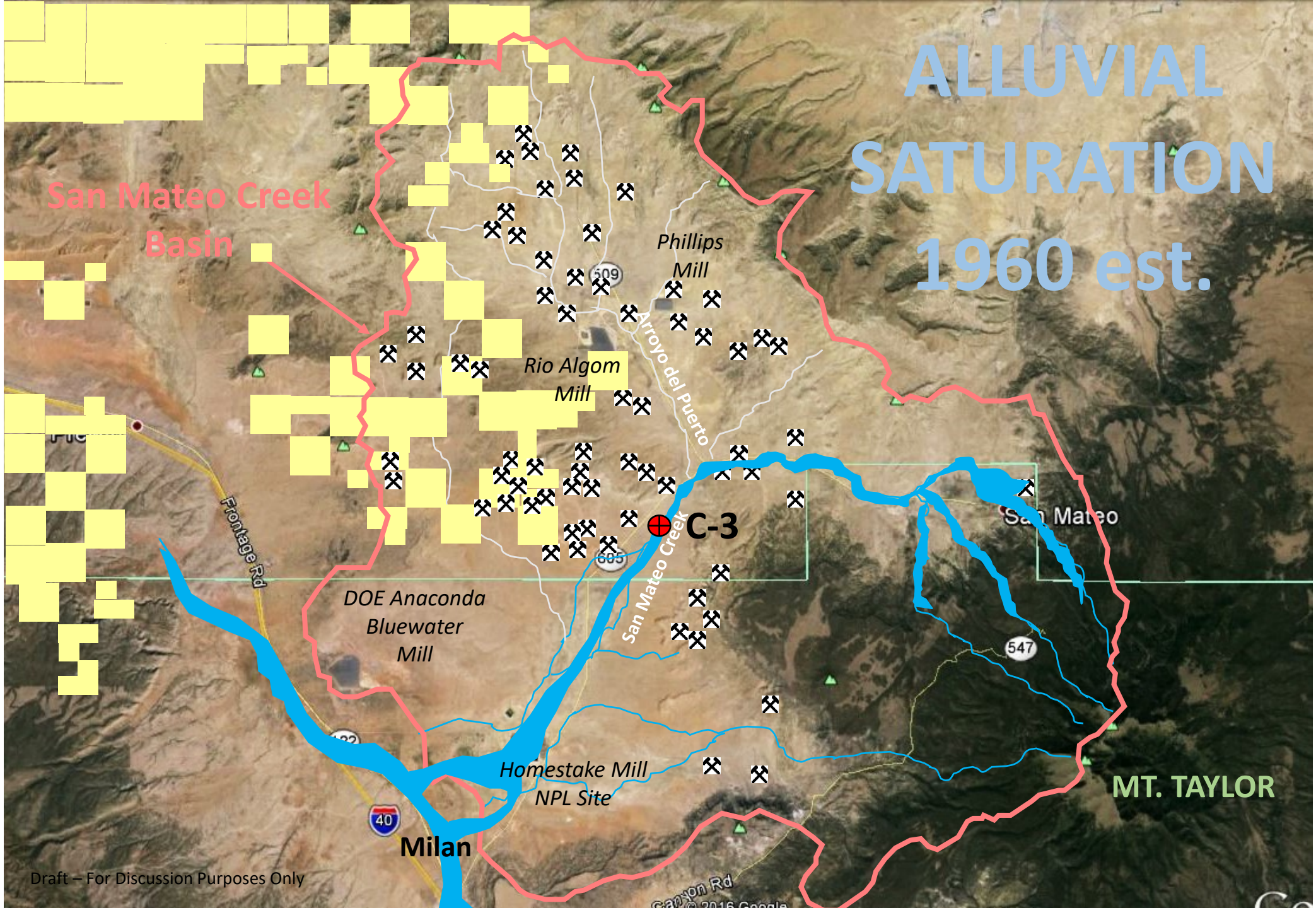

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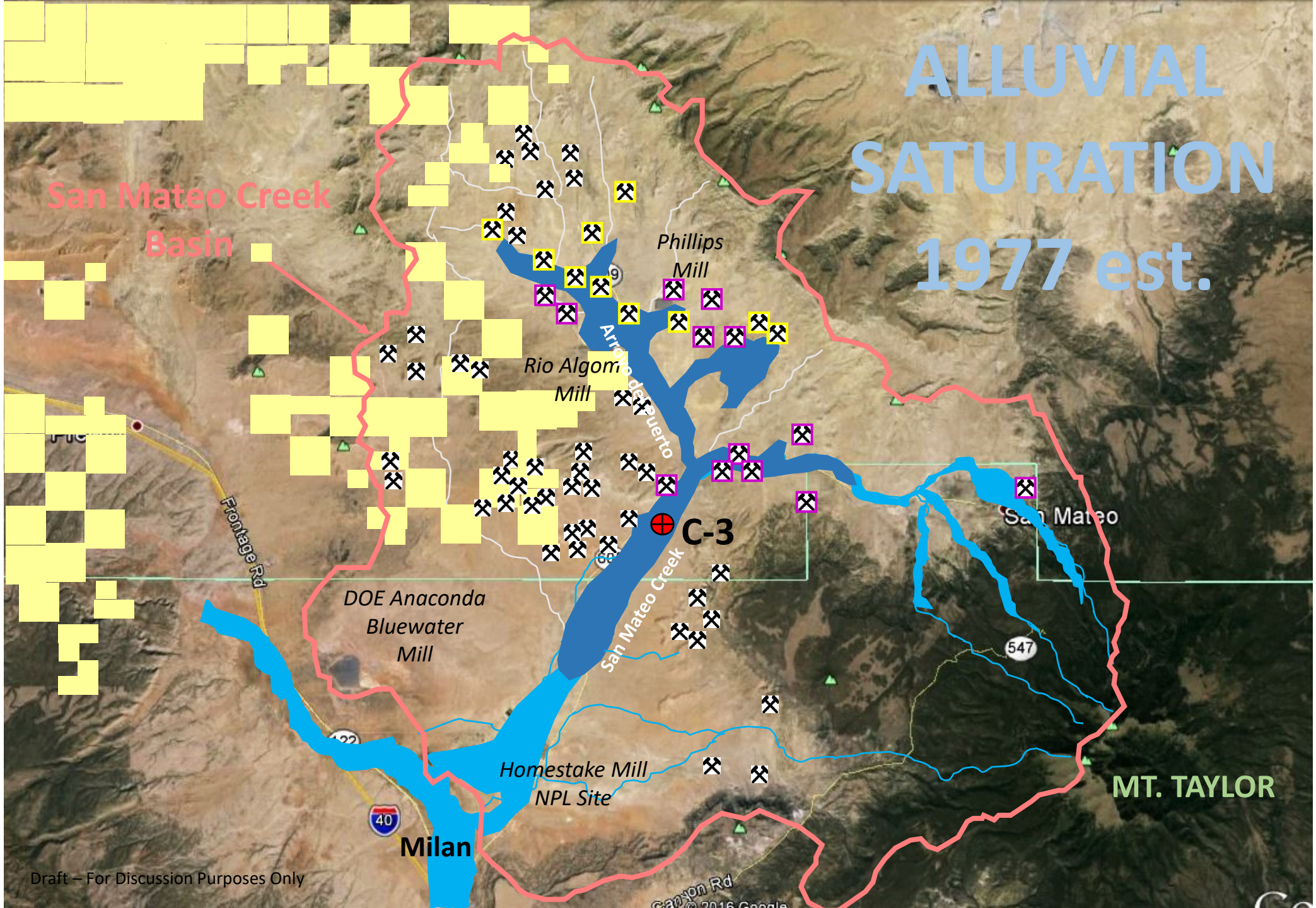

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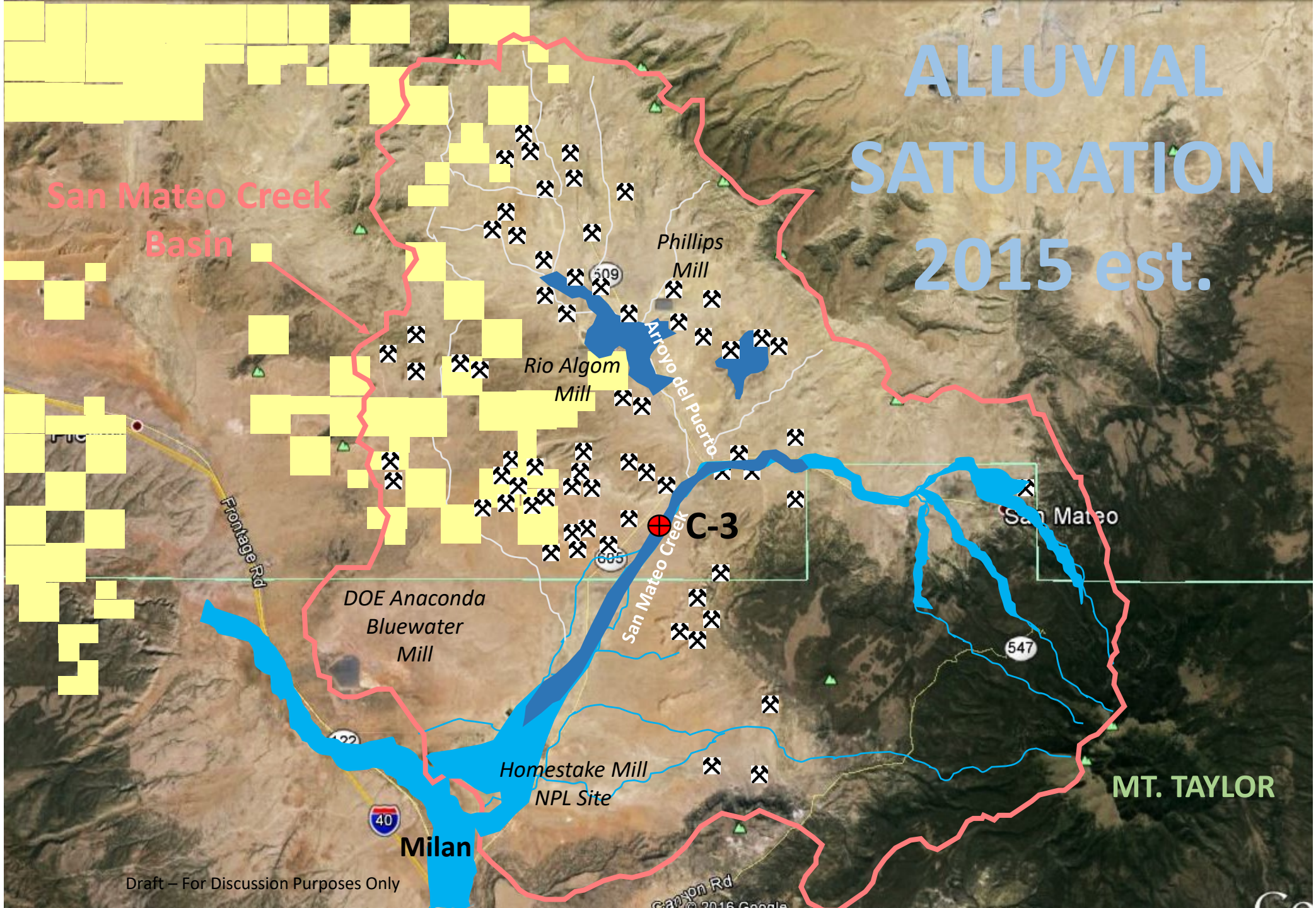

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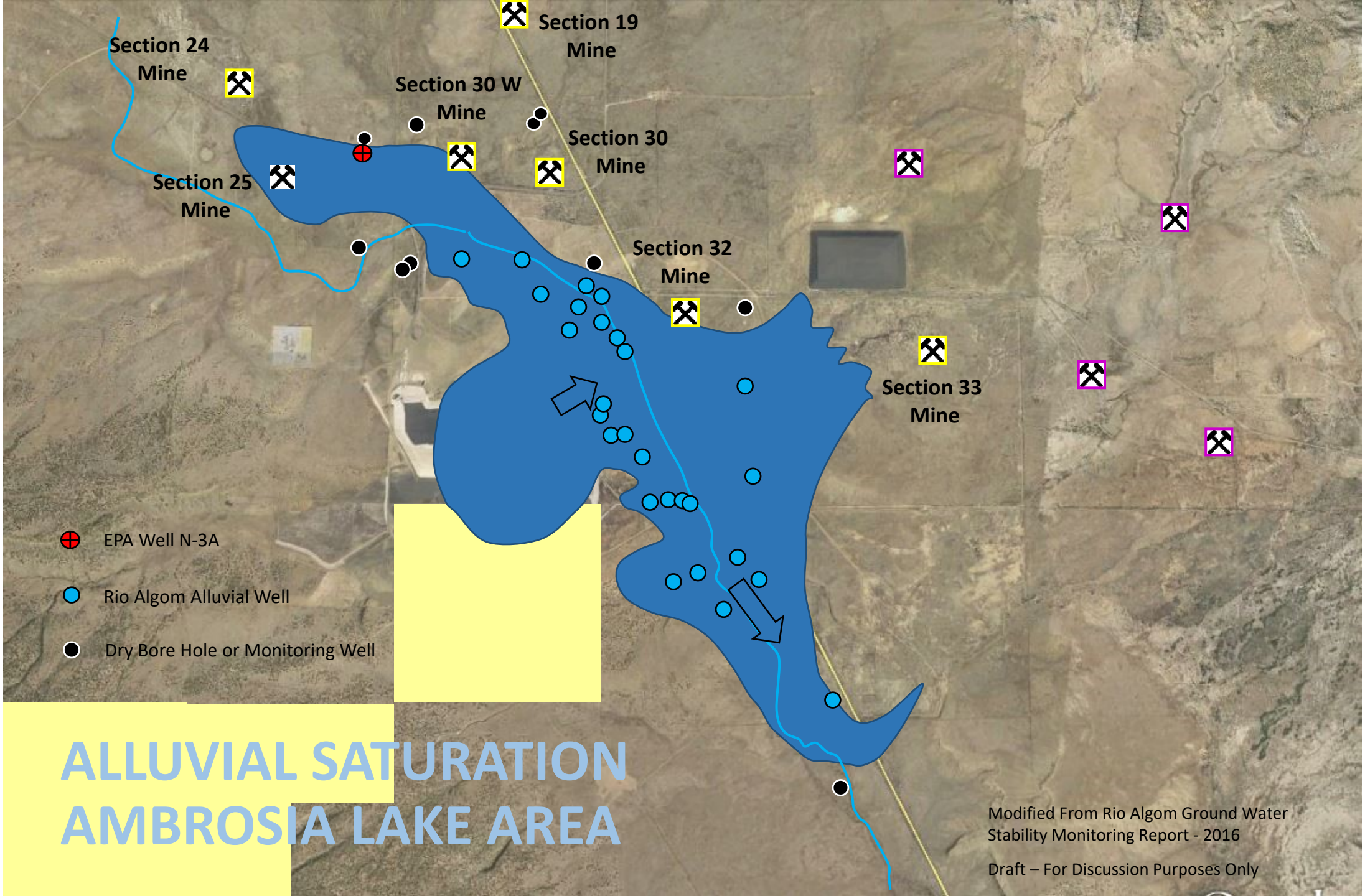
Section 19
Mine
Section 24
Mine
Section 30 W
Mine
Section 30
Mine
Section 25
Mine
Section 32
Mine
Section 33
Mine
EPA Well N-3A
Rio Algom Alluvial Well
Dry Bore Hole or Monitoring Well
ALLUVIAL SATURATION
AMBROSIA LAKE AREA
Modified From Rio Algom Ground Water
Stability Monitoring Report - 2016
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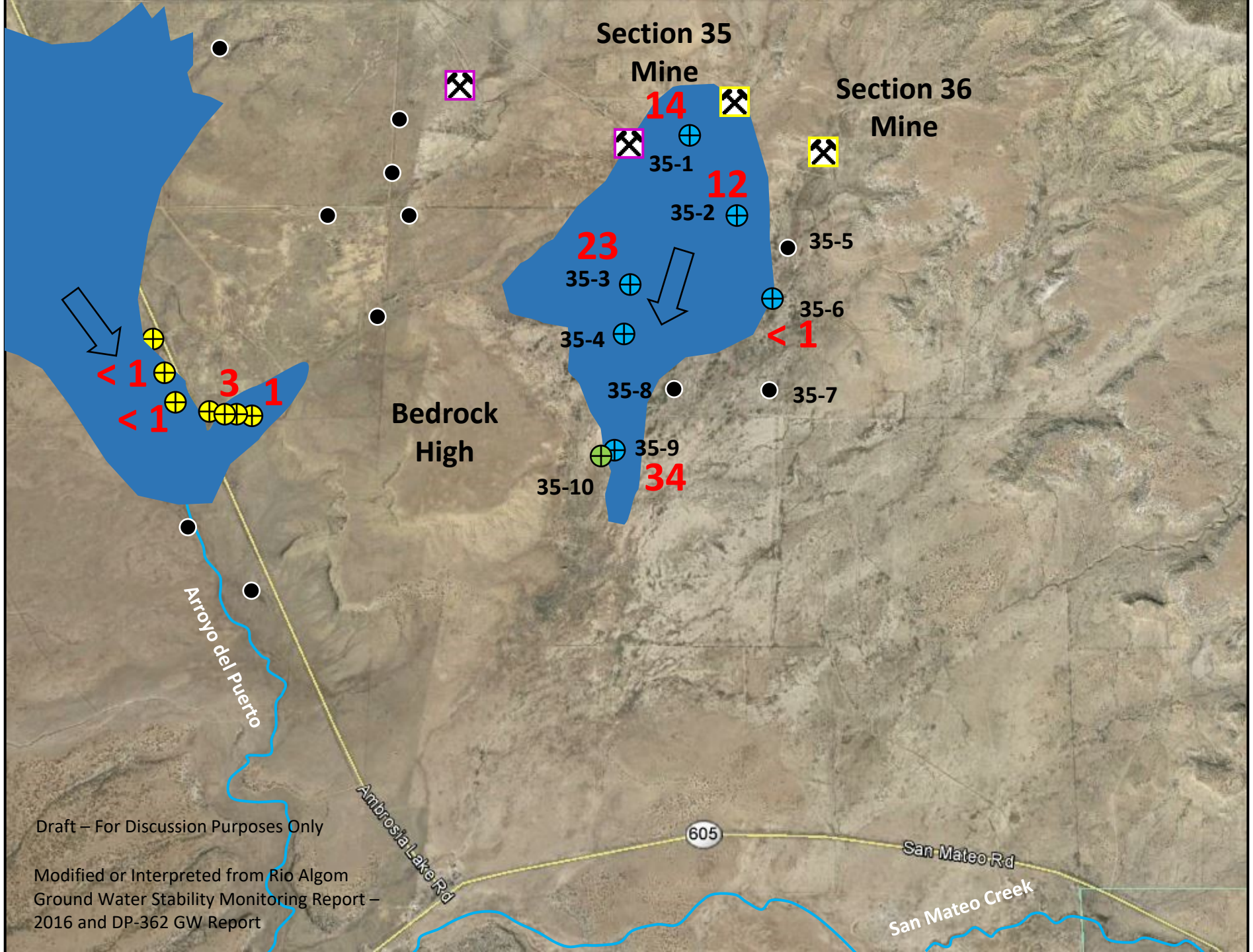
ALLUVIAL SATURATION SECTION 36 MINE AREA



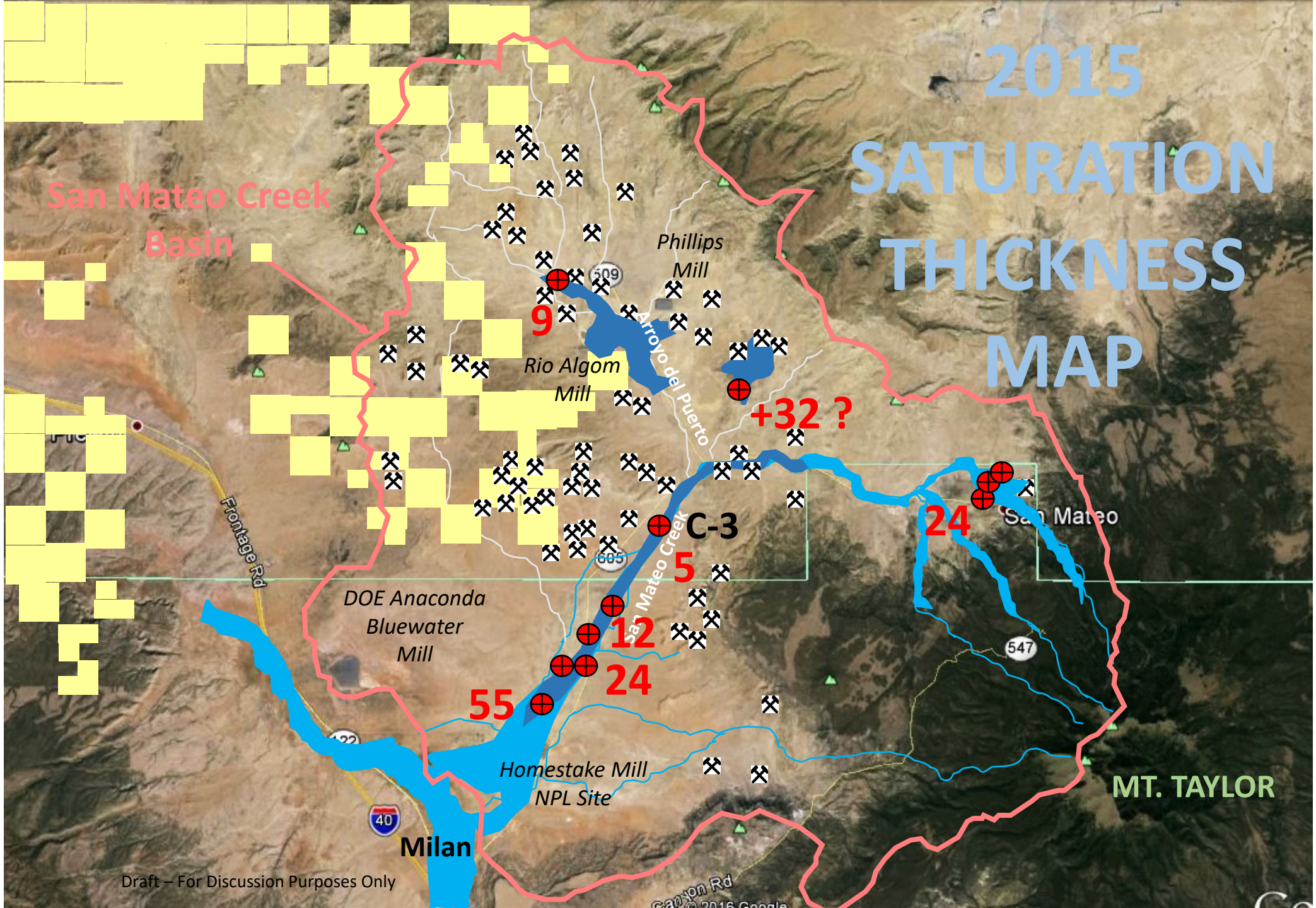
23 Saturation Thickness

● Dry Well

RAML Alluvial Monitoring Well – DP62

RAML Alluvial Monitoring Well – DP71

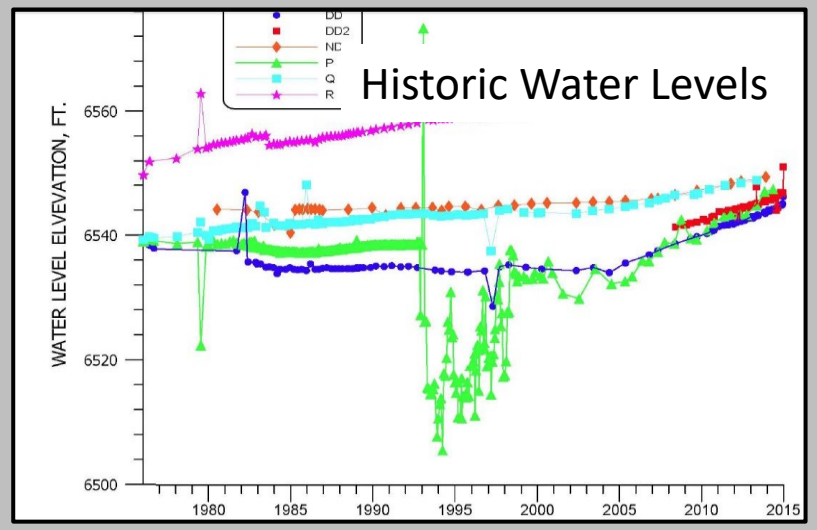
RAML Tres Hermanos C Monitoring Well


2015
SATURATION
THICKNESS
MAP
San Mateo Creek
Basin
Phillips
Mill
9
Rio Algom
Mill
Arroyo del Puerto
+32 ?
C-3
5
San Mateo Creek
24
San Mateo
Frontage Rd
DOE Anaconda
Bluewater
Mill
12
24
55
Homestake Mill
NPL Site
MT. TAYLOR
Milan
Draft – For Discussion Purposes Only

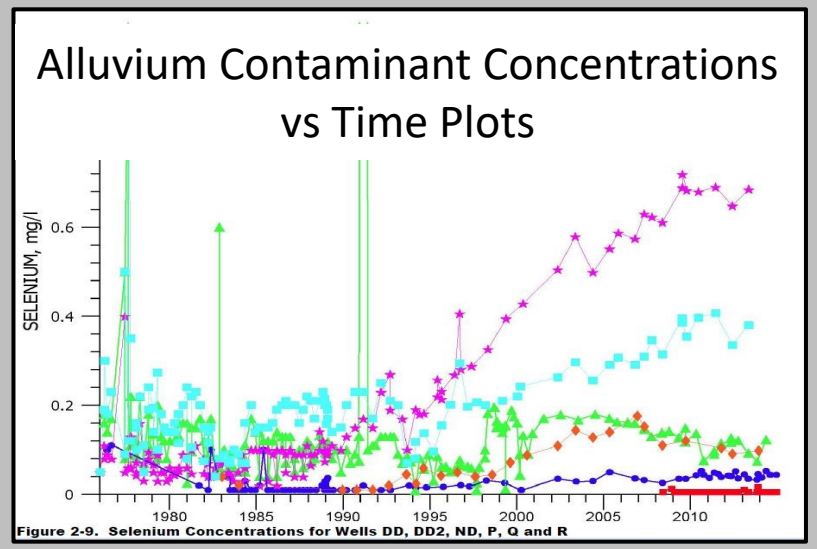
STATUS OF PHASE 2 INVESTIGATION

- Drilling/Sampling – 2015 to Early 2016
  - Focus on Dakota Sandstone – Ambrosia Lake Area
  - Alluvium – Central Basin
- Analytical Results – Summer 2016
- Data evaluation and interpretation – Ongoing
- Draft report preparation - Ongoing

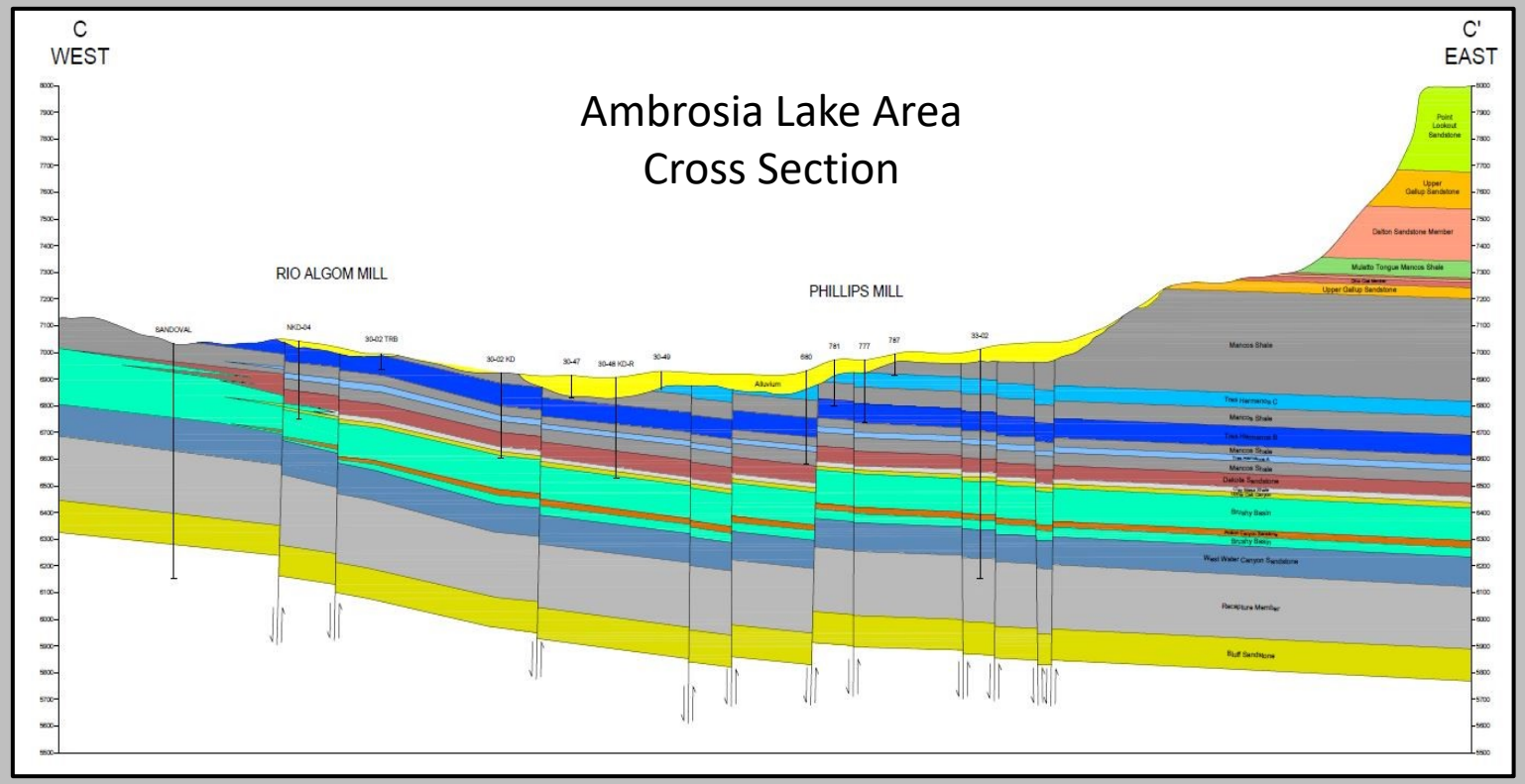
ONGOING PHASE 2 WORK



From Homestake Mining Company



From Homestake Mining Company



CONTAMINANT MASS LOADINGS FROM MINES

1		Section 35 Mine, Ambrosia Lake, NM									
2		Mass of Uranium, Molybdenum, & Selenium discharged from 1960 to 1976 before NPDES treatment required									
3											
4	LOWER MINE WATER DISCHARGE RATE										
5		Discharge Period	Discharge Rate GPM	minutes per day	million gallons per day (MGD)	AVG COC concentration in mine effluent (MG/L)	Formula: lbs/day = dose X flow x 8.34 lb/gal	AVG POUNDS PER DAY (lbs/day)	AVG POUNDS PER YEAR	16 YEAR TOTAL POUNDS DISCHARGED	16 YEAR TOTAL TONS DISCHARGED
6	URANIUM	1960-1976	850	1,440	1.22	5.25	(5.25 MG/L) X (1.22 MGD) X 8.34 lb/gal	53.59	19561.39	312982.19	156.49
7											
8	MOLYBDENUM	1960-1976	850	1,440	1.22	1.91	(1.91 MG/L) X (1.22 MGD) X 8.34 lb/gal	19.50	7116.62	113865.90	56.93
9											
10	SELENIUM	1960-1976	850	1,440	1.22	0.02	(0.02 MG/L) X (1.22 MGD) X 8.34 lb/gal	0.20	74.52	1192.31	0.60
11											
12											
13	HIGHER MINE WATER DISCHARGE RATE										
14		Discharge Period	Discharge Rate GPM	minutes per day	million gallons per day (MGD)	AVG COC concentration in mine effluent (MG/L)	Formula: lbs/day = dose X flow x 8.34 lb/gal	AVG POUNDS PER DAY (lbs/day)	AVG POUNDS PER YEAR	16 YEAR TOTAL POUNDS DISCHARGED	16 YEAR TOTAL TONS DISCHARGED
15	URANIUM	1960-1976	2,618	1,440	3.77	5.25	(5.25 MG/L) X (3.77 MGD) X 8.34 lb/gal	165.07	60249.07	963985.13	481.99
16											
17	MOLYBDENUM	1960-1976	2,618	1,440	3.77	1.91	(1.91 MG/L) X (3.77 MGD) X 8.34 lb/gal	60.05	21919.19	350706.97	175.35
18											
19	SELENIUM	1960-1976	2,618	1,440	3.77	0.02	(0.02 MG/L) X (3.77 MGD) X 8.34 lb/gal	0.63	229.52	3672.32	1.84

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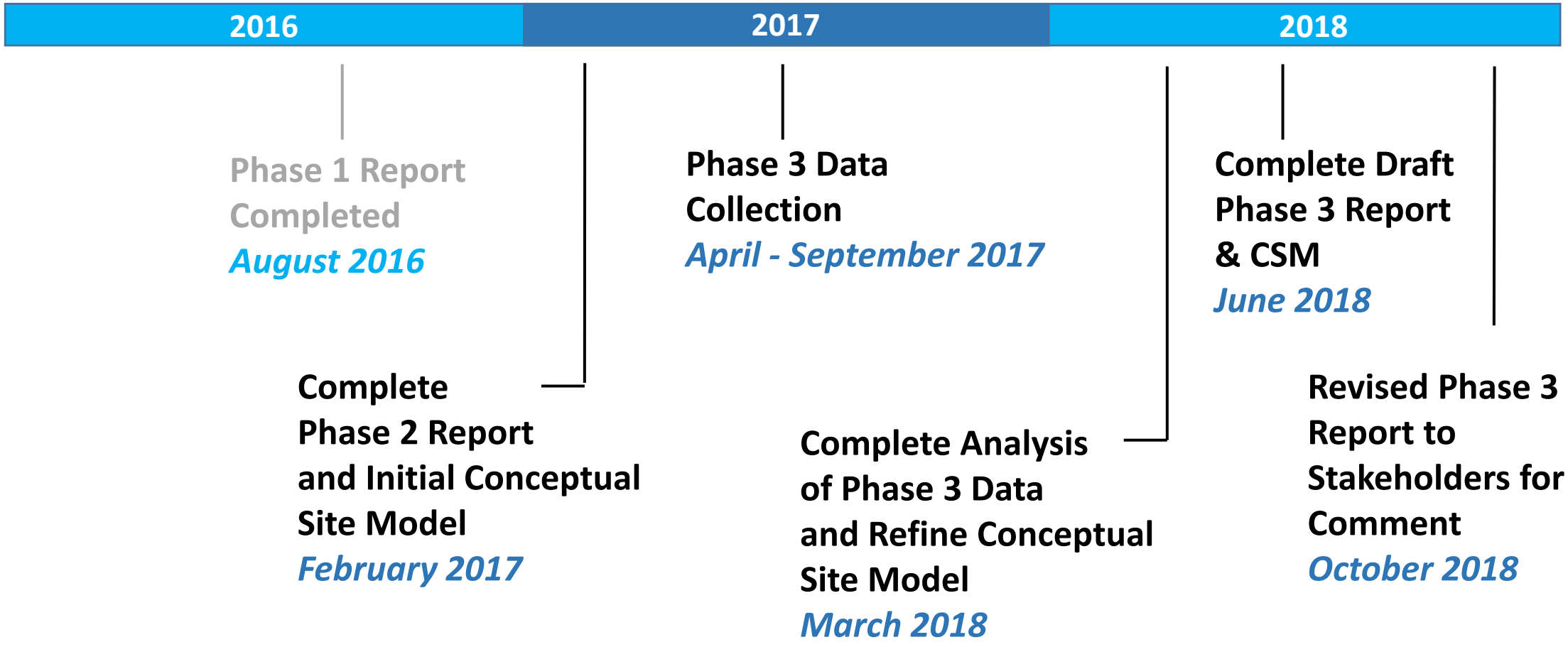
PLANNED ACTIVITIES FOR GROUND WATER INVESTIGATION